

**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of: **Frank J. Baresich**

Serial No: **Not Yet Assigned** Examiner: **Not Yet Assigned**

Filed: **Herewith** Group Art Unit: **Not Yet Assigned**

For: **MOLD FOR OPTIMIZING COOLING TIME TO FORM MOLDED ARTICLE**

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

**PRELIMINARY AMENDMENT**

Please amend the subject patent application as follows:

**IN THE SPECIFICATION**

Replace the paragraph entitled "Cross Reference to Related Applications" at page 1, lines 2-5, with the following paragraph:

- This is a division of application SN 09/421,189, filed October 19, 1999, now U.S. Patent No. \_\_\_\_\_, which is a continuation in part of application SN 08/857,762, filed May 15, 1997, now issued as U.S. Patent No. 6,019,930, which is a continuation in part of pending application SN 08/516,100, filed August 17, 1995, which is a continuation of application SN 07/913,136, filed July 14, 1992, both now abandoned.

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## IN THE CLAIMS

Cancel the original claims and insert the following claims in their stead:

1. A mold for optimizing molding time to form a molded article by cooling and solidifying a molten molding material, said mold comprising:

(1) at least one mold die coupled to a temperature controller operable to maintain a molding temperature of the mold die during at least part of a molding cycle;

(2) a stamper disposed in the mold, the stamper defining a portion of a mold cavity of which at least a part tends to cool to a temperature below a temperature of an other portion of the mold cavity; and,

(3) a further heating control coupled to the stamper so as to increase the temperature of the part that tends to cool below the temperature of said other portion of the mold cavity;

wherein the further heating control maintains the temperature of the part the tends to cool below said temperature, above a molding temperature of the molding material during a portion of the molding cycle, during which the temperature controller maintains the mold die at a temperature that would otherwise permit the molding material to solidify at said part.

2. The mold of claim 1, wherein the further heating control is placed to correspond with one of changes in thickness of the cavity and edges of the cavity.

3. The mold of claim 1, further comprising at least one insulator disposed between the stamper and the mold die for affecting a temperature of the cavity adjacent to said insulator during at least a portion of the molding cycle.

4. The mold of claim 1, wherein the molded article is an optical disc.

5. The mold of claim 2, wherein said cavity has differing thicknesses at different locations, causing different heat flow from the cavity surfaces to the mold dies at the different locations and wherein the further heating control compensates for temperature conditions for at least certain of the different locations.

6. The mold of claim 2, wherein the cavity defines a thin disc and the further heating control applies heat to a peripheral edge of the cavity.

7. A mold for an optical disc, comprising:

a mold cavity defining cavity surfaces for receiving a molten molding material to be cooled and solidified to form the optical disc;

a stamper forming at least a part of the cavity surfaces;

a stamper heating means is located in the mold die substantially adjacent to a periphery of the optical disc.

8. A method of optimizing molding time to form a molded article comprising the steps of:

(a) providing a mold containing a plurality of mold portions forming a mold cavity having cavity surfaces in a shape of said molded article, said mold portions comprising: at least one die having a stamper for imparting the shape and a thermal control means for determining a temperature at least in part of the mold cavity;

(b) applying substantially constant temperature control stimuli to said mold die via said thermal control means, such that the cavity surfaces of the mold cavity are brought to predetermined temperatures that are initially below a mold filling temperature required to produce the molded article and upon contact with molten material introduced into the mold cavity at a temperature greater than the mold filling temperature, increase a temperature of the cavity surfaces at least to the mold filling temperature required to produce the molded article;

(c) introducing molten material into the mold cavity, whereupon heat flows from the molten material to the primary booster and temperatures of the cavity surfaces increase at least to the mold filling temperature required to produce the molded article;

(d) while the cavity is filling with molten material, maintaining said cavity surfaces at least at the mold filling temperature required to produce the molded article by operating the thermal control means to increase a temperature at portions of the cavity surfaces that would otherwise cool below the mold filling temperature while the cavity is filling; and,

(e) after the cavity is substantially full, permitting heat to flow from the molding material to the die such that the molding material solidifies.

9. The method of claim 8, wherein the thermal control means comprises a stamper heating means located in the mold die substantially adjacent to a periphery of the cavity and in thermal communication with the stamper.

10. The method of claim 9, wherein the stamper heating means is located in the mold die of an optical disc mold in a vicinity of an outer diameter of the cavity and in thermal communication with the stamper.

#### **REMARKS**

Applicant hereby commences a divisional application wherein the supplemental heat added to the stamper, particularly at the peripheral edge of a stamper for imparting the surface configuration to an optical disc, is sufficient to hold the temperature of the molding material above the molding temperature of the material as the mold is filled.

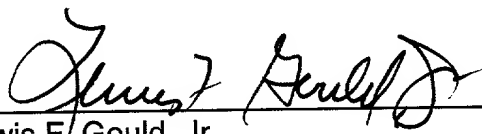
As explained in the specification, keeping the temperature of such a selected part elevated, above over the temperature to which it would otherwise cool, can keep the material adjacent to the heater molten for a longer time during filling, preferably until the mold is just filled. As a result, the starting temperature of the molding material as a whole can be lower that would otherwise be possible, and/or the beginning cycling temperature maintained in the mold can be lower than would otherwise be possible, without suffering from premature solidification of portions of the molded article (i.e., solidification of the edges of the disc before the mold has been filled).

The invention permits a mold to be operated at an overall cooler temperature or permits the molten material to be added at a lower temperature, than would be possible without such a heater. Although the invention concerns adding heat, which might be expected to lengthen the molding cycle time, the effect is actually to decrease molding cycle time as compared to a comparable molding setup in which that molding material or mold is sufficiently hot from the outset that solidification does not commence at the periphery (or other thin or easily cooled part of the cavity) as the mold is filled.

Applicant requests entry of this preliminary amendment prior to examination and before calculating the filing fee.

Respectfully submitted,

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Version Showing Changes

IN THE SPECIFICATION

The paragraph entitled "Cross Reference to Related Applications" at page 1, lines 2-5, has been changed as follows:

- This is a division of application SN 09/421,189, filed October 19, 1999, now U.S. Patent No. \_\_\_\_\_, which is a continuation in part of application SN 08/857,762, filed May 15, 1997, now issued as U.S. Patent No. 6,019,930, which is a continuation in part of pending application SN 08/516,100, filed August 17, 1995, which is a continuation of application SN 07/913,136, filed July 14, 1992, both now abandoned.

IN THE CLAIMS

1. A mold for optimizing molding time to form a molded article **by cooling and solidifying a molten molding material**, said mold ~~[containing a plurality of mold portions forming a mold cavity having cavity surfaces in a shape of said molded article, said mold portions]~~ comprising:

(1) at least one mold die **coupled to a temperature controller operable to maintain a molding temperature of the mold die during at least part of a molding cycle** ~~[having at least one primary booster adjacent to and in thermal communication therewith, said mold die providing structural support for said primary booster];~~

(2) **a stamper disposed in the mold, the stamper defining a portion of a mold cavity of which at least a part tends to cool to a temperature below a temperature of an other portion of the mold cavity** ~~[said primary booster being disposed in the mold cavity and forming at least a part of the cavity surfaces, the primary booster being made of material whose mathematical product of thermal conductivity, density, and specific heat is no more than  $2.0 \times 10^{-6}$  BTU<sup>2</sup>/sec/in<sup>4</sup>/°F<sup>2</sup> at room temperature, and having predetermined thicknesses ( $W_b$ ) as calculated from the equation]~~

$$[W_b = Y \sqrt{\frac{k_b t_f}{\rho_b C_b}}]$$

$$[0.25 \leq Y \leq 4.0]$$

[where  $t_f$  is a time to fill the mold,  $k_b$  is thermal conductivity,  $\rho_b$  is density, and  $C_b$  is specific heat of the primary booster]; and,

(3) a further heating control coupled to the stamper so as to increase the temperature of the part that tends to cool below the temperature of said other portion of the mold cavity; [thermal control means for applying temperature control stimuli to the mold die]

wherein the further heating control maintains the temperature of the part the tends to cool below said temperature, above a molding temperature of the molding material during a portion of the molding cycle, during which the temperature controller maintains the mold die at a temperature that would otherwise permit the molding material to solidify at said part.

2. The mold of claim 1, wherein the further heating control is placed to correspond with one of changes in thickness of the cavity and edges of the cavity. [primary boosters vary in thickness at different locations on the cavity surfaces.]

3. The mold of claim 1, further comprising at least one insulator disposed between the stamper and the mold die for affecting a temperature of the cavity adjacent to said insulator during at least a portion of the molding cycle. [edge temperature boosters on the cavity surfaces, the edge temperature boosters being

made of materials whose mathematical product of thermal conductivity, density, and specific heat is no more than  $2.0 \times 10^{-6}$  BTU<sup>2</sup>/sec/in<sup>4</sup>/°F<sup>2</sup> at room temperature.]

4. The mold of claim 1, wherein the molded article is an optical disc.

[5. ~~The mold of claim 1, further comprising secondary boosters, the secondary boosters being located between at least a part of said primary boosters forming the cavity surfaces, and said mold dies, the secondary boosters being in thermal communication with both the primary boosters and the mold dies, the secondary boosters being made of materials whose mathematical product of thermal conductivity, density, and specific heat is less than that of the adjacent primary boosters, whereby the secondary boosters restrict heat flow from the primary boosters for improving build-up of heat in the primary boosters, the secondary boosters having thicknesses ( $W_{sb}$ ) as calculated from the equation~~

$$[W_{sb} = Z \sqrt{\frac{k_{sb} t_f}{\rho_{sb} C_{sb}}}]$$

$$0.025 \leq Z \leq 4.0$$

where  $t_f$  is the time to fill the mold,  $k_{sb}$  is the thermal conductivity,  $\rho_{sb}$  is the density, and  $C_{sb}$  is the specific heat of the secondary booster.

5 [6]. The mold of claim 2 [5], wherein said cavity has [primary and secondary boosters have] differing thicknesses at different locations, causing different heat flow from the cavity surfaces to the mold dies at the different locations **and wherein the further heating control compensates for temperature conditions for at least certain of the different locations.**

6. The mold of claim 2, wherein the cavity defines a thin disc and the further heating control applies heat to a peripheral edge of the cavity.



7. A mold for an optical disc, comprising:

a mold cavity defining cavity surfaces for receiving a molten molding material to be cooled and solidified to form the optical disc;

~~[The mold of claim 5, further comprising] a stamper forming at least a part of the cavity surfaces; [~~said stamper being in thermal communication with at least one said primary booster.~~]~~

~~[8. The mold of claim 7, further comprising a stamper heating means:]~~

~~[9. The mold of claim 8, wherein the] a stamper heating means is located in the mold die substantially adjacent to a periphery of the **optical disc** [~~primary booster and in thermal communication with the stamper.~~]~~

~~—— [10. The mold of claim 8, wherein the stamper heating means is located in the mold die of an optical disc mold in a vicinity of an outer diameter of the cavity and in thermal communication with the stamper.]~~

~~—— [11. The mold of claim 8, wherein the heating means is at least partially thermally insulated from the mold die.]~~

~~—— [12. The mold of claim 8, wherein the heating means is electrical resistive heating.]~~

**8** ~~[13].~~ A method of optimizing molding time to form a molded article comprising the steps of:

(a) providing a mold containing a plurality of mold portions forming a mold cavity having cavity surfaces in a shape of said molded article, said mold portions comprising: **[(+)] at least one die having a stamper for imparting the shape and a thermal control means for determining a temperature at least in part of the mold cavity;** ~~[at least one primary booster adjacent to and in thermal communication therewith, said die providing structural support for said primary booster;~~

~~(2) said primary booster being disposed in the mold cavity and forming at least a part of the cavity surfaces, the primary booster being made of material whose mathematical product of thermal conductivity, density, and specific heat is no more than  $2.0 \times 10^{-6}$  BTU<sup>2</sup>/sec/in<sup>4</sup>/F<sup>2</sup> at room temperature, and having predetermined thicknesses ( $W_b$ ) as calculated from the equation~~

$$W_b = Y \sqrt{\frac{k_b t_f}{\rho_b C_b}} \quad \text{--- } 0.25 \leq Y \leq 4.0 \text{ ---}$$

~~where  $t_f$  is a time to fill the mold,  $k_b$  is thermal conductivity,  $\rho_b$  is density, and  $C_b$  is specific heat of the primary booster;~~

~~(3) thermal control means for applying temperature control stimuli to the die;~~

(b) applying substantially constant temperature control stimuli to said mold die via said thermal control means, such that the cavity surfaces of the mold cavity are brought to predetermined temperatures that are initially below a mold filling temperature required to produce the molded article and upon contact with molten material introduced into the mold cavity at a temperature greater than the mold filling temperature, increase a temperature of the cavity surfaces at least to the mold filling temperature required to produce the molded article; [~~whereby because of the mathematical product of thermal conductivity, density, and specific heat of the primary booster according to said equation, the temperatures of the cavity surfaces are initially lower than for materials with higher corresponding products;~~]

(c) introducing molten material into the mold cavity, whereupon heat flows from the molten material to the primary booster and temperatures of the cavity surfaces increase at least to the mold filling temperature required to produce the molded article;

(d) while the cavity is filling with molten material, maintaining said cavity surfaces at least at the mold filling temperature required to produce the molded article **by operating the thermal control means to increase a temperature at portions of the cavity surfaces that would otherwise cool below the mold filling temperature while the cavity is filling;** and,

(e) after the cavity is substantially full, permitting heat to flow from the molding material to the die such that the molding material solidifies [~~flowing from the primary booster to the die to cool the primary booster and the cavity surfaces, thereby optimizing cooling time~~].

[14. ~~The method of claim 13, further comprising in step (c) using primary and secondary boosters cooperatively to bring the temperature of the cavity surfaces at least to the mold filling temperature required to produce the molded article, the secondary boosters being located between at least a part of said primary boosters forming the cavity surfaces, and said mold dies, the secondary boosters being in thermal communication with both the primary boosters and the mold dies, the secondary boosters being made of materials whose mathematical product of thermal conductivity, density, and specific heat is less than that of the adjacent primary boosters, the secondary boosters thereby restricting heat flow from the primary boosters for improving build up of heat in the primary boosters, the secondary boosters having thicknesses ( $W_{sb}$ ) as calculated from the equation~~

$$W_{sb} = Z \sqrt{\frac{k_{sb} t_f}{\rho_{sb} C_{sb}}} \quad \text{--- } 0.025 \leq Z \leq 4.0 \text{ ---}$$

where  $t_f$  is the time to fill the mold,  $k_{sb}$  is the thermal conductivity,  $\rho_{sb}$  is the density, and  $C_{sb}$  is the specific heat of the secondary booster.

[15. ~~The method of claim 14, wherein the molded article is an optical disc, and further comprising the step of transferring digital information to at least a part of a surface of the optical disc from a stamper that forms at least a part of the cavity surfaces and is in thermal communication with at least one said primary booster.~~

--- [16. ~~The method of claim 15, further comprising a stamper heating means.~~

9 ~~17~~. The method of claim 8 ~~[16]~~, wherein the thermal control means comprises a stamper heating means ~~[is]~~ located in the mold die substantially adjacent to a periphery of the cavity ~~[primary booster]~~ and in thermal communication with the stamper.

10 ~~[18]~~. The method of claim 9 ~~[16]~~, wherein the stamper heating means is located in the mold die of an optical disc mold in a vicinity of an outer diameter of the cavity and in thermal communication with the stamper;

~~19. The method of claim 16, wherein the stamper heating means is at least partially thermally insulated from the mold die.~~

~~20. The method of claim 16, wherein the stamper heating means is electrical resistive heating.]~~

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